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ABSTRACT

A project is described that developed prototype materials in support of a proposed refresher training concept for use in providing proficient maintenance training in the Naval Reserve. (Another focus of the study was the use of microcomputers as a vehicle for presenting prototype materials.) The philosophy of Naval Reserve training on which the proposed concept for refresher training is based is presented, and the study approach used to construct the prototype materials is described. Next, the prototype materials, an operational scenario and a related training game, which would provide practice in a supporting knowledge or skill area, are presented. Their operation is described through reproductions of printed frames generated by a microcomputer on which the prototypes were run. Explanatory information and commentary appear. Issues related to the design and use of sample prototypes are identified, and the potential application of this refresher training concept is discussed. Appendixes include the computer programs developed in support of the prototype materials and reprinted information describing a commercially available computer simulation exercise that might be used to extend the application of the proposed refresher training concept. (YLB)

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Technical Report 148

A TECHNIQUE FOR REFRESHER TRAINING IN THE NAVAL RESERVE

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Training Analysis and Evaluation Group

July 1983

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Training to achieve readiness for mobilization in time of war or national emergency is the major peacetime task of the Naval Reserve. Since nearly all Naval Reserve personnel have served with active duty Navy forces, most have completed the initial formal training and/or on-the-job training associated with their respective designators, ratings, and billets. A primary objective of Naval Reserve training is the maintenance of these previously acquired proficiencies and skills. (con't on reverse)

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20. ABSTRACT (continued)

The Training Analysis and Evaluation Group reviewed a strategy based on the use of an operational scenario for refresher training which had been proposed for development and use in the Naval Reserve. Preliminary review established that its general application and use in Navy training was feasible.

This study developed prototype scenario and training game materials in support of the proposed refresher training strategy. These prototype materials are for use in providing proficiency maintenance training in the Naval Reserve. The study also explored the use of microcomputers as a vehicle for presenting prototype materials.

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SECTION I

INTRODUCTION

The primary mission of the Naval Reserve (NR) is to mobilize trained individuals and units for active duty in time of war or national emergency. Training to achieve readiness for mobilization is the major peacetime task of the Naval Reserve. Increasingly, this training is designed to support the immediate reinforcement or augmentation of active force components. Because nearly all NR personnel have served with active duty Navy forces, most have completed the initial formal training and/or on-the-job training associated with their respective designators, ratings, and billets. In many cases, billets to which NR personnel would be mobilized require skills and abilities developed during this period of active duty. Hence, a primary objective of NR training is the maintenance of these previously acquired proficiencies and skills.

In addition, increased emphasis is being placed on the peacetime use of the Naval Reserve to support the active duty components of the Navy on a continuous basis. Increased articulation between active and reserve force components is a goal of the "Total Force" policy of the Chief of Naval Operations (CNO). To this end, active components have reviewed and revised their support requirements. Members of NR components must acquire or maintain the proficiencies and skills necessary to respond to those requirements.

Both mobilization and continuing support requirements imply a need to identify and use optimum and appropriate training technologies to ensure that previously acquired skills do not deteriorate. Indeed, one measure of NR readiness for mobilization, and of NR value for continuing support, is the extent to which these proficiencies and skills are maintained. The usual means of meeting such training needs involve unit training at Naval Reserve Centers (NRC), weekend training (WET) at mobilization sites, and short periods of active duty for training (ACDUTRA). However, at some NRCs, inadequate space, insufficient numbers of qualified instructors, and/or a lack of appropriate training equipment may exist. Moreover, platforms for ACDUTRA and WET drills are not always available, and such training is scheduled on an infrequent basis. Training procedures and technologies to support or enhance proficiency maintenance must be developed in light of these limitations.

BACKGROUND

Support of NR training is a mission element assigned to the Chief of Naval Education and Training (CNET). In early 1981, the CNET tasked[1] the Training Analysis and Evaluation Group (TAEG) to review a concept for refresher training which had been proposed for development and use in the Naval Reserve. This concept, designed for classroom use, is built on a format which uses a predeveloped scenario to set an operational context for an exercise. Using scenario events as a stimulus, a small group of participants is asked to recall previous active duty experiences, to discuss

[1]CNET ltr Code 022 of 5 Feb 1981.

them, and to apply the lessons learned from those experiences to the series of events presented in the scenario. Through this process, previously acquired abilities and skills of each individual are recalled and reapplied. A microcomputer had been suggested as the primary medium to present this format. Specifically, the TAEG was tasked to:

- elaborate on the strengths and weaknesses of the concept for NR refresher training
- suggest methods for designing and constructing components of the concept so training effectiveness is maximized, and
- suggest quality control criteria.

Preliminary review by the TAEG of the proposed concept established that its general application and use in Navy training was feasible.[2] During this preliminary evaluation, concept components and related training techniques were identified. The preliminary review also identified questions which should be addressed as part of further development or implementation of the refresher training concept. Based on the findings of the preliminary review, CNET requested that the TAEG develop prototype materials sufficient to demonstrate this refresher training concept. A description of these actions is provided in the present report.

PURPOSE

The purpose of the present study was to develop prototype materials in support of the proposed refresher training concept. These prototype materials are for use in providing proficiency maintenance training in the Naval Reserve. Included in the tasking was exploration of the microcomputer as a vehicle for presentation of the concept.

STUDY CONSTRAINTS

This study was restricted to the development of a prototype operational scenario and a related training game. Subject matter used for the development process was selected arbitrarily from material already available to study team members. No inferences about the universal applicability of this concept to other subject matter, the extent of its application, or its potential effectiveness, should be drawn.

Initial development of the refresher training prototype materials were directed to:

- Naval Reserve, Surface Program component
- mobilization assignments in operational-oriented billets in the active force component of the Navy
- NR drills not normally conducted on an operational platform

[2]CNET ltr TAEG:EAH Serial W1341 of 9 Oct 1981.

- training directed to a single designator/rating/watch group
- individuals requiring maintenance/refresher training in previously acquired proficiencies or skills.

ORGANIZATION OF THE REPORT

In addition to this introduction, the report contains three additional sections and three appendices. Section II presents a more complete description of the NR training philosophy on which the refresher training concept is based and describes the study approach used to construct the prototype materials. Section III presents the prototype materials and describes their operation. A summary of observations and conclusions about the design and use of sample prototypes is found in section IV. A brief discussion of the potential application of this refresher training concept is also included in this section.

Appendices A and B contain the computer programs developed in support of the prototype materials. Appendix C provides information, reprinted with permission, describing a commercially available computer simulation exercise which might be used to extend the application of the proposed refresher training concept.

SECTION II

PHILOSOPHY AND APPROACH

This section presents the philosophy of NR training on which the proposed concept for refresher training is based and describes the technical approach followed to construct the prototype materials.

A TRAINING PHILOSOPHY FOR THE NAVAL RESERVE[3]

The Naval Reserve consists of more than 400,000 men and women of whom some 265,000 are currently active. Of this number, more than 90,000 are classified as members of the Selected Reserve (SR). Selected Reserve members are paid to perform regular inactive duty training (weekend drills) at some 240 training centers throughout the country and also serve 2 weeks of ACDUTRA with the active forces each year. This group makes up about 12 percent of the Navy's trained military manpower and is comprised of NR personnel available for immediate mobilization. Nearly all of the officers and about 85 percent of the enlisted personnel in the SR have completed 2 or more years of active duty. Most reservists have thus received initial and on-the-job training prior to their entry in the reserve.

Historically, the counterparts of today's Navy Selected Reserve forces were usually assigned mobilization billets which required them to reactivate supplementary equipments which had been reserved for such eventualities. Today, however, such inventory is limited and, in many cases, does not reflect the technological advances found in current weapons, sensors, and electronic equipment. As a result, today's concept of SR mobilization emphasizes the immediate reinforcement and augmentation of the active forces.

Figure 1 depicts a "life cycle" context for Naval Reserve training, in which the maintenance of previously acquired skills and proficiencies is emphasized. Persons recruited into the Navy are initially trained, gain initial experience in schools and/or on active duty, and acquire and use additional skills, knowledge, and proficiencies until they leave the active forces. The Naval Reserve gets the bulk of its membership from those who leave active service matching, as near as possible, personal experience and background to mobilization readiness requirements.

In the context described by figure 1, the reserve training needed to help in maintaining skills and abilities previously acquired would be made available in individual NR units. Unfortunately, such training may not currently be possible, in part because facilities may be inadequate and in part because adequate instructional formats for such training do not yet exist. It should be noted that the difference shown in figure 1 between skill degradation for personnel with and without training to maintain knowledge and skills is an estimate and is provided only for descriptive purposes.

[3]Much of the historical background contained in this section was taken from a brief on the Naval Reserve prepared by the Chief of Naval Operations (OP-09RD), revised in June 1981.

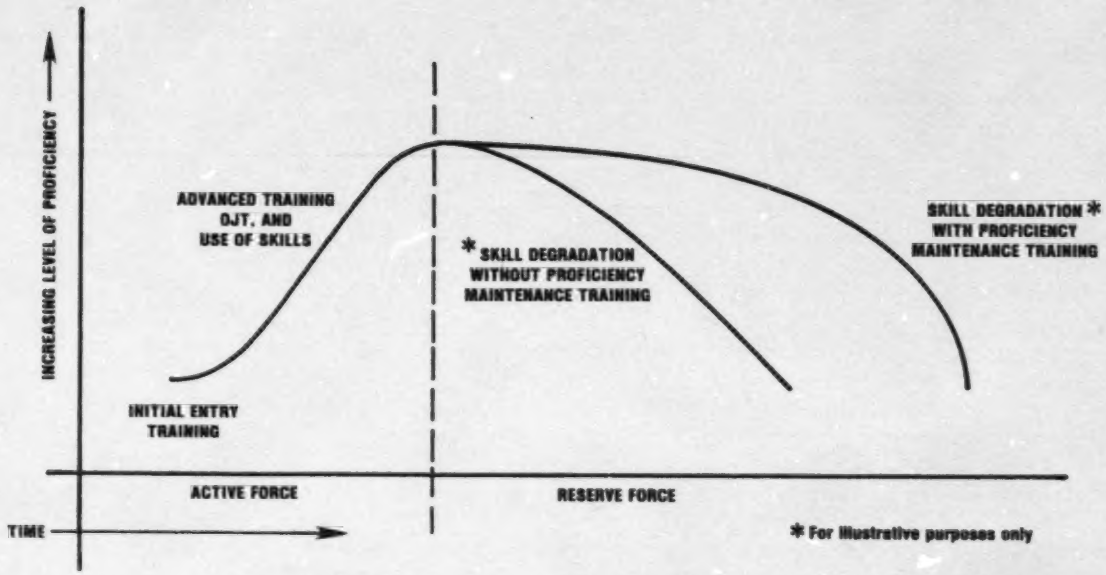


Figure 1. A Strategy for Life-Cycle Proficiency Maintenance Training

TECHNICAL APPROACH FOR PROTOTYPE DEVELOPMENT

The technical approach used to develop the prototype is described in terms of the three phases used in the development of the demonstration materials. Phase I concerned selection of a subject area for use in the demonstration. The primary criterion for selection was the existence of a requirement for identifiable refresher training knowledges or tasks. In phase II, a learning strategy for accomplishing this refresher training was specified and a medium was selected to present it. In phase III, the actual demonstration materials were created. Accompanying the paragraphs describing phase III are the flow charts used in prototype development and information about the computer language used for authoring.

PHASE I: SELECTING SUBJECT MATERIAL/TASKS FOR DEMONSTRATION. Four criteria were established to select a subject area for demonstration by the prototype. Knowledges or tasks in the subject area should be ones that:

- are performed by reservists while on active duty
- probably would not be retained at a useful level by reservists after 1 year or more in the fleet reserve
- would be required of these reservists in mobilization billets
- probably could be maintained at reserve training centers using carefully selected refresher training techniques.

The general subject area of navigation and piloting was selected for demonstration. Tasks in this subject area are performed by personnel assigned the duties of the Officer/Junior Officer of the Deck and enlisted personnel in those ratings that serve on ships' navigation teams. They are applicable to both mobilization billet and continuing support requirements. The following tasks are a representative but incomplete list of those in this subject area which meet established selection criteria:

- recognize navigation lights
- apply Rules of the Road
- understand/recognize the effects of relative motion
- develop navigation plots
- apply piloting skills.

PHASE II: LEARNING STRATEGIES FOR REFRESHER TRAINING. For refresher training to be effective, students need to experience a range of job situations involving information or skills previously acquired but impaired through disuse. Job-like problems should be varied and practice in solving them should be interesting. The process should provide feedback on the quality of performance. Remediation exercises should be immediately available when specific information or skills require additional practice. Provision may also be made to enhance gradually the degree of complexity and realism of the training.

Learning Strategy Selection. A simple diagram of the strategy recommended to satisfy these refresher training requirements is displayed in figure 2. The primary component is an operational scenario which simulates actual situations and provides both a framework and a context for refresher training.[4] This scenario is supported by training games which provide remediation and/or practice in specific topic or skill areas. In most cases, relatively simple simulation is expected to accomplish required training. However, when desirable, increasingly dynamic situations may be developed and presented by enhancing the kinds and levels of simulation used. In figure 2, this optional feature is shown by the dotted lines. Microcomputers are suggested for use as the primary medium for presenting information, although other media might also be employed. Small and relatively low in cost, these machines are readily available, are easily dispersed and used, and permit the random generation of specific problem elements and data.

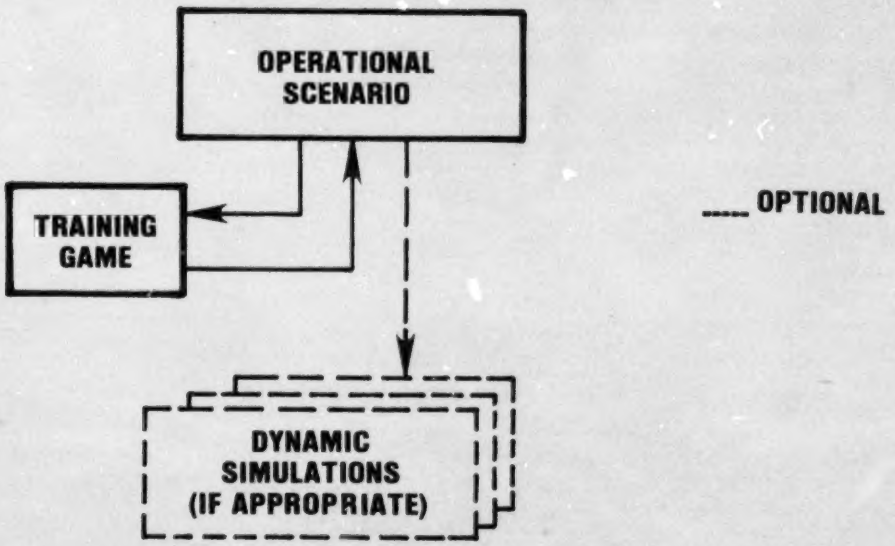


Figure 2. Strategy for Refresher Training

[4]Initially, the term "tactical resume" was used to define this particular kind of scenario as well as to describe the proposed concept for refresher training. Both the term and the concept were developed by CAPT Dewey A. Dyer, USNR, during his tenure as CNET Special Assistant for Reserve Affairs and Readiness Training. The term was originally coined by British aviators during World War II to describe post-combat discussions of aerial tactics and maneuvers. Because the potential applications of the concept go beyond tactics, the more generic phrase "operational scenario" is used in this report. However, in deference to the original phrasing, the prototype scenario is titled "tactical resume."

The primary component of the proposed strategy, the operational scenario, is an exercise conducted by a small group seated around a conference table. It is characterized by:

- the presentation of a series of detailed "snapshots" of an operational situation
- a group discussion to assess the significance of the situation, to detect problems, and to form a consensus on a course of action
- a discussion of actions that might be taken rather than actually taking some action
- an evaluation of the group's decisions by the group leader.

The primary purpose of the scenario is to present a sequence of realistic job situations in which information must be collected and evaluated, and decisions made. Its intent is to stimulate experienced people to recall how they dealt with, or to plan how to deal with, these or similar situations and to rehearse mentally the necessary operations required to respond to the situation. If the information required to perform these operations cannot be recalled, remediation will be required. While the operational scenario creates conditions in which individuals recreate past job situations, it does not itself provide remediation or new learning if the required information is not recalled or the required skills are not remembered and described.

Training games are that supporting component of the refresher training strategy in which the relearning of information components of lost skills takes place. These training games are designed to aid in relearning those forgotten facts, procedures, or the like that must be recalled quickly and accurately when performing the job. There are two broad types of training games both of which have significant potential for use in refresher training situations. In strategy games (e.g., chess), opposing players interact and interfere with the other's performance. In showdown games (e.g., golf), each player attempts to exhibit his best performance without interference from other players. Both types of training games are contests where players operate under formal rules and the objective is to win.

In a recently developed variation in training game design, a computer takes the part of an opposing player(s). Using the capability available in these machines, training games can be designed to exercise an individual systematically in the recall and application of specific job or task information. They can also be designed so that the attention of the user is maintained until relearning has taken place. In the proposed refresher training strategy, a training game may be applied before, during, or after that training predicated on the operational scenario.

As shown in figure 2, dynamic simulation techniques can be applied to this strategy for refresher training. When employed, such techniques provide training of progressively greater complexity and/or realism. This kind of simulation is usually presented through complex exercises which differ from operational scenario exercises in that they are dynamic models

of a system rather than static representations (snapshots) of it. Dynamic simulation permits students to apply real world and/or real time decisions to specific problems and to observe realistic responses to those decisions. These more sophisticated simulations are especially useful in practicing the application of complex information or skills. It should be noted, however, that as the complexity, fidelity, and realism of simulations increase, costs increase greatly. The dynamic simulation exercises suggested here reflect the less complicated and less costly end of a continuum of simulation types.

Selecting Demonstration Media. The medium selected to demonstrate the operational scenario and training games is a microcomputer. The reasons for choosing this medium included the following:

- The flexibility and speed of the computer makes possible the efficient management of instructional events. Such a system can demand acceptable response from students before advancing a program. It can provide immediate feedback to students for each trial in an exercise, and can schedule distributed practice (repetition of items over specified lengths of time) according to a formal logic.

- Use of the computer permits random selection of variables and the assignment of random values to each variable. This capability provides a unique set of learning events on each pass through the program, and helps to maintain interest during repetitions.

- Instruction which involves the use of computers appears to hold the attention and interest of students for the length of time required for training. This phenomenon may be a result of the relative newness of computer applications to training or it may be that the medium taps a natural interest people have in technology. Games of this type promote intrinsic job satisfaction which is salutary to effective performance.

- The use of authoring aids, and the extensive external storage capacity available for access by inexpensive microcomputers, provide potential reductions in the cost of authoring, producing and maintaining extensive libraries of complex instructional material. Authoring aids are easily used computer routines which automate the authoring process and reduce significantly the time required to create complex instructional materials. Using automated authoring, materials can be developed by subject matter specialists, with minimum help from educational technologists.

- A single microcomputer can be programmed to run both operational scenarios and/or training games for refresher training in the proposed strategy. This flexibility eliminates the need for specific equipments to perform specific functions.

PHASE III: CREATING DEMONSTRATION MATERIALS. The prototype operational scenario, and a prototype computer-based training game were developed by the TAEG using locally available material. Flow charts were developed and used to specify the flow of instructional events in each prototype and to guide

programmers in developing the computer code. No dynamic simulation exercises were developed because these exercises are an optional part of the strategy. Commercial training simulation programs are available to demonstrate this optional feature and one such exercise is described later in this section.

The flow charts and events described in the following paragraphs are only one example of a wide variety of potential instructional programs. For scenarios and training games in other subject areas, the flow of instructional events may vary depending on training objectives.

Flow Chart for the Operational Scenario. The cycle of specific events to be built into the prototype operational scenario is shown in figure 3. In step 1 of that flow chart, the computer is programmed to provide problem direction and background information. Next, team members select the basic characteristics of the scenario problem. For this prototype, these variables include the type of ship to be employed, and alternate locations of the harbor. In step 3, the first problem is displayed by the computer. In step 4, team members may request and display additional information, if that is necessary for an understanding of the situation or for developing a course of action. In step 5, a series of preprogrammed questions are asked, to be answered by the team and evaluated by the team leader in step 6. The program then determines (step 7) if the scenario contains additional events. If so, the program cycles back to step 3 and the exercise continues. When all events in the scenario have been completed, the program ends.

Flow Chart for the Training Game. The cycle of specific events developed to make up this supporting component of instructional strategy is outlined in figure 4. Background information and general directions are again presented in step 1. In step 2, the student establishes a level of difficulty by selecting whether or not to impose time limits as part of the exercise. If the student chooses the "Easy" mode, no time limit is imposed for responding. If the "Hard" mode is chosen, only a few seconds are allowed for each answer. A randomly selected primary question with response alternatives is presented in step 3. If the program determines (step 4) that the student-selected response is correct, bonus questions are displayed in sequence (step 5). All bonus questions are directly related to the most recent primary question answered correctly. Additional bonus questions are displayed as long as they are answered correctly (step 6) or until the program completes all bonus questions (step 7) for the primary question. When any question is missed, an answer frame containing information on the primary question and all bonus questions is displayed. For demonstration purposes the game ends when the student misses three primary questions or when all primary questions have been answered correctly (step 8). Appropriate messages, including a final score, may be displayed in step 9.

Characteristics of the Demonstration Computer System/Language. The operational scenario and the training game demonstration programs software are constructed to run on an Apple II microcomputer system containing 64K memory. Two floppy disk drives and a CRT monitor are required as peripherals. Software programs are written using Apple Super Pilot, a high level, commercially available language designed for use in creating instructional programs. The use of Apple Super Pilot simplified the task of

building the routines called for in the flow charts and was particularly helpful in the construction of the many graphics required to present navigation/piloting information. Apple Super Pilot, which became available late in 1982, proved superior to its predecessor, Apple Pilot, in the ease with which graphics could be designed and in the running speed of the programs. Continuing technological advances in systems and software design can be anticipated and should prove useful for developing future instructional programs. Program listings for the two routines are presented in appendices A and B, together with directions for running the two programs.

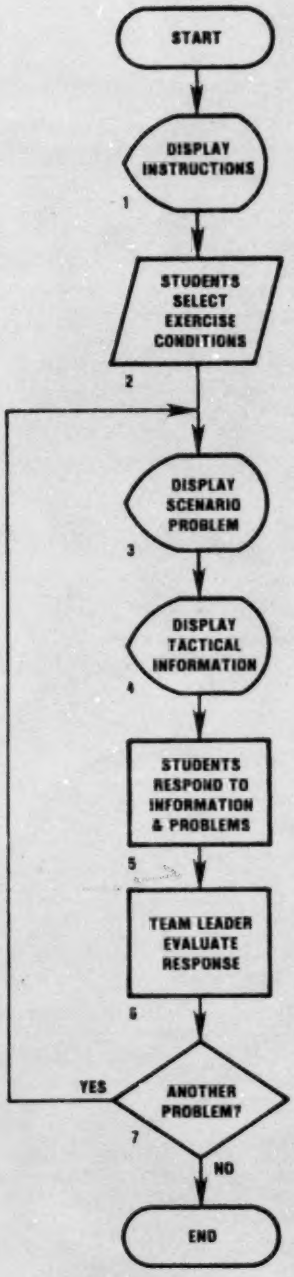


Figure 3. Flow Chart for Operational Scenario

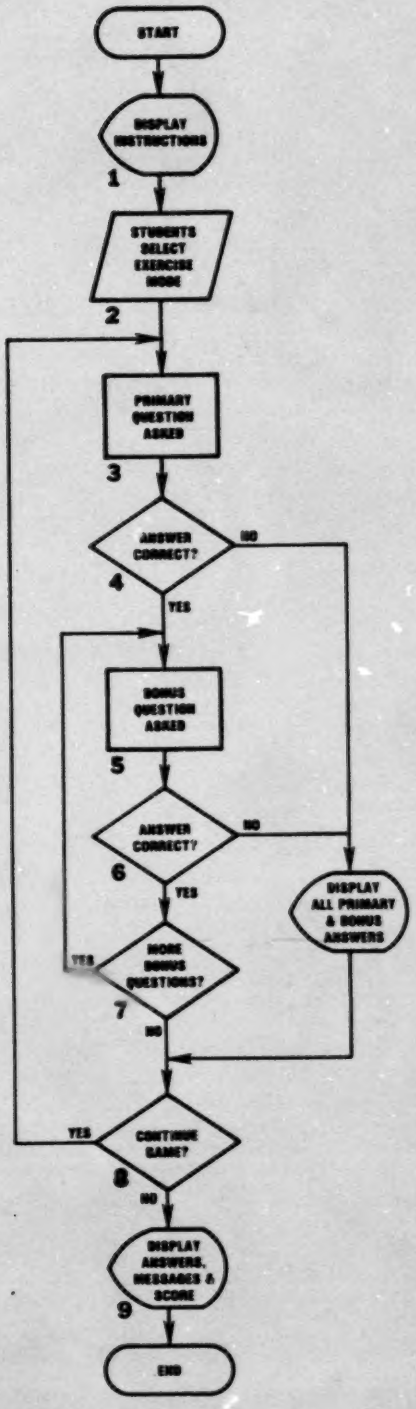


Figure 4. Flow Chart for Computer-Based Training Game

SECTION III

OPERATIONAL SCENARIO AND TRAINING GAME PROTOTYPES

This section provides a prototype operational scenario and a prototype training game which would provide practice in a supporting knowledge or skill area. To facilitate their description, both prototypes were run on a microcomputer, and copies of the video frames generated by the computer programs were printed. Sequences of those printed frames are reproduced in this section and are incorporated in the discussion which follows. In the following paragraphs, video frames are printed in heavier, stylized type. The words, figures, and diagrams shown in this heavier type are exactly what a student would see. Explanatory information and commentary appear in regular type near the video frame being described. The intent of this format is to permit the video displays to convey the bulk of the description of the prototypes; commentary is added to clarify or to highlight features of interest.

A commercially-available exercise using dynamic simulation techniques which might be added later to provide more realistic navigational training is also described. Each of the components is presented and discussed separately.

THE OPERATIONAL SCENARIO[5]

The operational scenario is initiated by inserting the designated program and picture disks into the microcomputer disk drives.[6] The internal computer loading procedure is completed automatically and the title page appears.

TACTICAL RESUME
NAVIGATION & PILOTING
(HARBORS & CHANNELS)
■

[5]The title given to the prototype scenario is "Tactical Resume" which was assigned in deference to its association with the original concept and planning.

[6]Copies of the computer disks developed for this study are held by the CNET (Code 019) and by the TAEG. Disk programs are provided in appendices A and B.

Pressing the return key produces the following display:

```
                TACTICAL RESUME

     The "Tactical Resume" is a method for
     providing refresher training to Naval
     Reservists. It provides training through
     presentation of a scenario that contains
     events common to an operational
     situation.
      Under a group leader, small groups of
     participants view the events, define and
     evaluate the situation, and recommend
     courses of action to be taken.

     Press the space bar to continue...■
```

Pressing the space bar produces the following display:

```
   In addition to the scenarios, each
Tactical Resume contains exercises in
skill areas associated with the
topic/subject being studied.  Exercises
available are identified at the
beginning of each subject area.

Press the space bar to continue...
```

When the space bar is pressed, the following frame is produced:

```
 Select a topic or subject area from the
list below by pressing the appropriate
letter.

(A) Navigation and piloting (Harbors &
Channels) for officers/ship navigation
team.

(B) Navigation and piloting (Open Ocean)
for officers/ship navigation team

(C) Electronic navigation for QM/SM/ship
navigation team.

(D) General damage control for all
hands.

■
```

This is the subject selection step. The list of available topics will consist of those subjects for which specific operational scenarios have been developed. For purposes of this demonstration, selecting choice A (the only alternative now available) and pressing the space bar when specified produces the following display sequence:

```
NAVIGATION AND PILOTING
HARBORS & CHANNELS

The information that follows is
designed to help you remember and review
some of the events and actions
associated with the navigation and
piloting of a navy ship in harbors and
channels.

The scenario that will be presented to
you contains specific events that
require you to define and evaluate a
situation and to decide on reasonable
courses of action.

Press space bar to continue...
```

```
Participants should try to reach
group consensus when responding to
questions.  The group leader will
determine how reasonable and accurate
your decisions are.

Since the information describing
contacts, lights, ship characteristics,
and the like are created randomly,
there are no 'correct' answers.

Press space bar to continue...
```

```
  Optional exercisess associated with
this subject are:

      (1) Navigation light recognition
      (2) Maneuvering board practice

  If at any time during the scenario
you feel that you need to sharpen your
skills in one or more of these areas,
you can respond to a question with the
answer '0' and instructions on how to
access these modules will appear.

Press space bar to continue...
```

The exercises referred to here are the training games which are described fully in a later part of this section. The number and content of games available would be dependent on the nature of the material and the level of proficiency being taught. Note that the student group may enter the "game" position of this exercise at any time.

Pressing the space bar displays the following frame:

```
  From the list below, select the
harbor you would like for this
scenario:

          (1) Newport, RI
          (2) New York, NY
          (3) Norfolk, VA
          (4) Charleston, SC
          (5) Mayport, FL

Press the number of your choice...
```

This choice among harbors permits individual NR personnel or units to exercise their skills using the characteristics of specific home ports to which they are assigned. Within an operational scenario, although general conditions and requirements remain the same for each exercise, questions may be developed to reflect conditions applicable to a specific unit (e.g., the harbor selected). Student responses would then be required in light of those conditions. If desired, conditions such as harbor selection could be made randomly by the computer itself. For this demonstration, the harbor at New York is used. It is selected by pressing the number "2" on the computer console keyboard. The following statement is then displayed.

```
  You have chosen to pilot through the
harbor/channel at New York.  You will
need to locate chart number 12327 for
use in this exercise.  Other necessary
equipment includes:

    parallel rulers, dividers, scratch
paper, blank maneuvering board sheets,
and such reference materials as you
think you need.

  I will wait until you have located
all of these materials.

Press space bar to continue...
```

Having selected a harbor, the student group is directed to obtain specific support materials. A reproduction of nautical chart 12327 is provided for information as figure 5. After required materials have been obtained, the space bar is pressed and the following is displayed:

```
From the list below, select the type of
ship you want your 'own ship' to be. If
you prefer, the computer will make a
random selection for you.

(1) destroyer
(2) guided missle frigate
(3) combat store ship
(4) mine sweeper
(5) random selection

Enter the number of your selection...
```

This menu permits the student group to select a ship whose characteristics most closely describe its mobilization platform. If desired, random selection of ship characteristics may be made by the computer. If the number (1) is selected, the following will appear:

```
Own ship information...

  You are piloting a destroyer

                Length = 450 ft
                 Width = 60 ft
                 Draft = 30 ft
                Shafts = 2
          Displacement = 8000 Tons
         Maximum speed = 30 kts
    Tactical diameter  = 700 yds

Press space bar to continue...
```

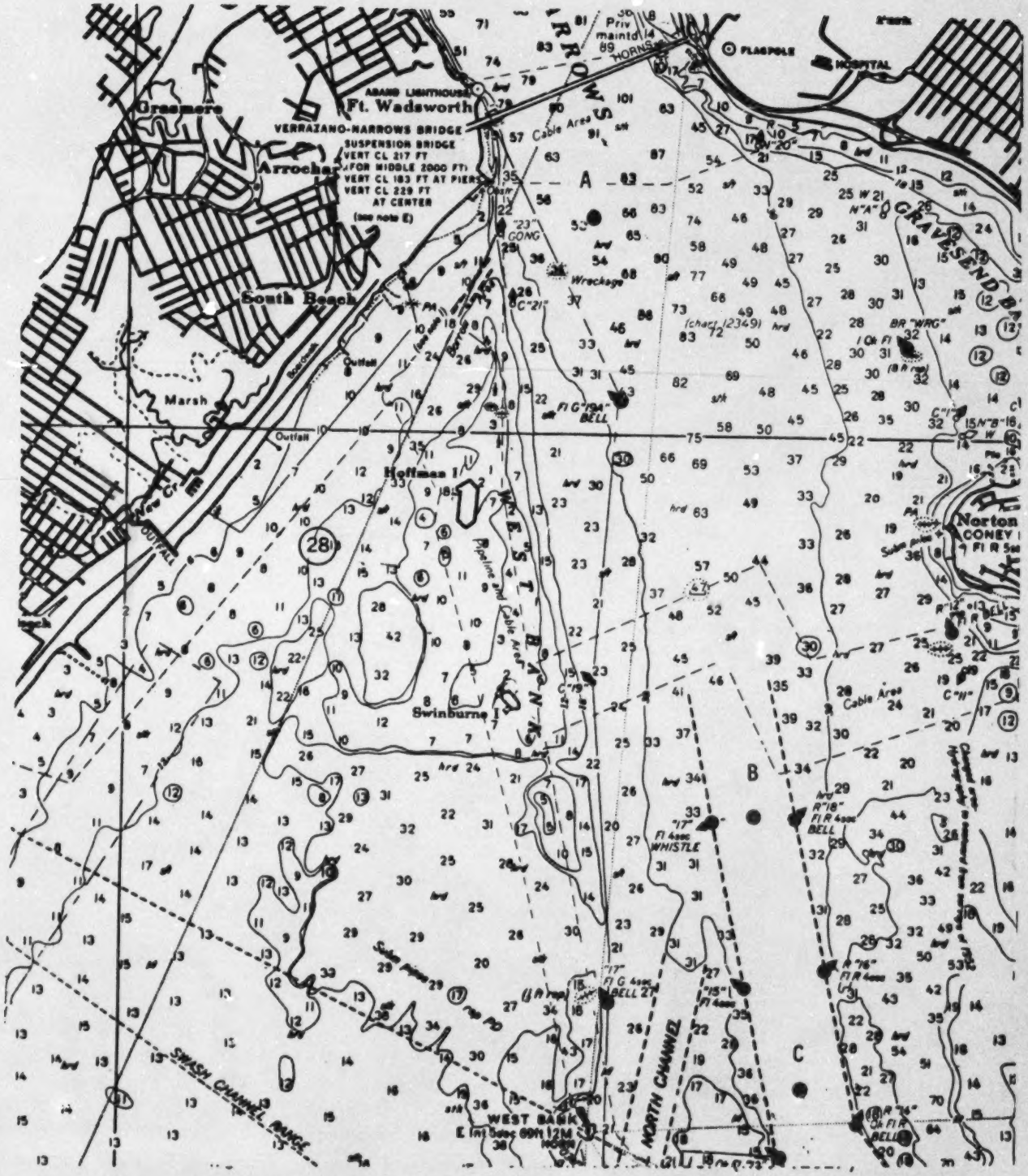


Figure 5. Nautical Chart of New York Harbor (No. 12327)

This display describes several essential own-ship characteristics needed to discuss navigation and piloting evolutions. The sample format displayed in this frame includes only seven common descriptors; the extent of a platform description may be made much more sophisticated should that be necessary for a given exercise.

The initial scenario problem begins with the next display. Before proceeding, however, it should be noted that many other conditions or circumstances could be developed and provided as a selection option to the student group. Specific climatic conditions (e.g., snow, fog, rain, wind), weapons and/or sensor configurations and availability, and particular engineering plant conditions might have been appropriate for this demonstration. The extent of the description of the platform would be determined by the nature and content of the material being taught.

Pressing the space bar produces the following:

```
        Situation                Chart no. 12327
                                 New York Harbor

 Your outbound vessel is in the vicinity
of point A on a course of 165T, speed is
10knts. It is night and other vessels
are in the vicinity that may be a hazard
to navigation. You are displaying navi-
gation lights but must reassess your con
dition to make sure you are displaying
the correct lights. Plot your location.

  visual sightings:
          Norton pt light        137t
          West bank light        181t
  radar contacts:
          Swinburne Is. neck     190t
          West U-N bridge        276t
  depth:
          Sonar sounding          91'
  tide current:
          Incoming port set
Press 'p' for previous page or 'c' to
continue to the next frame...
```

This display sets the initial problem parameters. For purposes of discussion, use the chart shown in figure 5 for reference. Alternative ownship positions in the "vicinity of point A" were predetermined during exercise development; visual and radar coordinates have been computed and loaded in the computer for each one. The computer randomly selects one of these alternatives and presents all information about that position to the student team. Team members plot the ship's position, which then remains constant until all questions associated with this part of the exercise have been presented and resolved.

To review again the characteristics of own ship, the letter "P" is pressed. If this is not desired, the letter "C" is pressed and the following display is produced:

```
                    Piloting

          Your vessel's condition is:

conditions normal.
underway, making way.

Press space bar to continue...■
```

Piloting conditions are provided in this display. A series of circumstances other than "normal, making way" (e.g., restricted speed or maneuvering capability because of an engineering casualty) might be developed and loaded if such conditions are appropriate for the subject being reviewed. Pressing the space bar causes the following display:

```
Radar range and bearing to contacts:
 1) 167T at 600yds.
 2) 128T at 600yds.
 3) 207T at 1000yds.

Press the number of the contact to view
the vessel's lights

 p) View previous page again
 c) Continue to next frame

 *** PROGRESSING TO THE NEXT       ***
 *** FRAME PROHIBITS SEEING PAST   ***
 *** FRAMES. BE SURE YOU HAVE ALL  ***
 *** THE NOTES YOU NEED!!!         ***
■
```

This video frame provides initial contact information. The number of contacts can vary as required--in this demonstration prototype two to five contacts will appear. Information on each contact's bearing, range, and light configuration, is developed randomly, but within predetermined limits. The randomness of contact information is constrained by the configuration of the harbor selected and by the specific point at which own ship is located within that harbor. Other contact information, such as course and speed, is not provided in this prototype scenario although such information might have been generated and included at this point. For this demonstration, lighting configurations of different kinds have been developed. One of these is randomly assigned to each contact. To find the lighting configuration for the contact bearing 167°T at 600 yards, the number 1 is pressed and the following is displayed:

Lights appear in color on the video screen. In this black and white representation, solid lights are white, vertical lined lights are green. The contact represented is a tug with short tow, proceeding to starboard.

When the student group has viewed all contacts and the letter "C" is pressed, the following display will appear:

G R O U P

Q U E S T I O N S

A) What is your location relative to point A?

B) If you are not at point A, what caused the discrepancy/deviation and what future actions must you take to account for it?

C) What navigation lights/day shapes should you display?

D) What are the characteristics of the radar contacts?

E) What other hazards are present?

F) What actions should be taken to minimize hazards to your vessel? Why?

This display provides a set of questions about conditions at (or around) point "A" to be discussed by the student group. Other questions could be developed if desired. Answers or alternative solutions to each question must be developed by students in the context of ship type, harbor, contact situation, and other conditions as they have developed. Because of the random selections of own-ship position and each contact, it is unlikely that repetitions of previous situations would occur were the exercise repeated.

It should be emphasized that the intent of the operational scenario format is to stimulate in student team members a recognition/remembrance of similar circumstances previously encountered. The discussion during and following each problem development is expected to stimulate the recall of previous occasions when those skills and proficiencies being exercised were used.

On completion of the discussions prompted by these (or similar) questions, this demonstration scenario proceeds to discussions of similar circumstances at points "B," "C," and following (figure 5). At each new point, randomly selected conditions, contacts, and lighting configurations are presented, causing situations to develop which serve to remind participants of similar situations--and responses--previously encountered.

THE TRAINING GAME

The training game is designed to provide practice to improve performance in a specific area of proficiency required by the operational scenario. Like the operational scenario, much of the material in the training game is randomly generated; unlike the scenario, however, the training game is constructed to accept only specific responses to questions asked.

In the computer-based training game demonstrated here, practice is made available in navigation light recognition. (Practice in maneuvering board procedures might also be made a training game in support of this general subject area.) This prototype training game is a "showdown" game, either initiated separately by loading the proper disks, or entered as part of the operational scenario by striking the "(shift)@" key when responding to requests for input from the computer. A training game program disk is identified to replace the scenario program disk (the second disk which contains the light configurations remains the same) and the following display appears automatically:

```
Welcome to the gaming portion of the
tactical resume

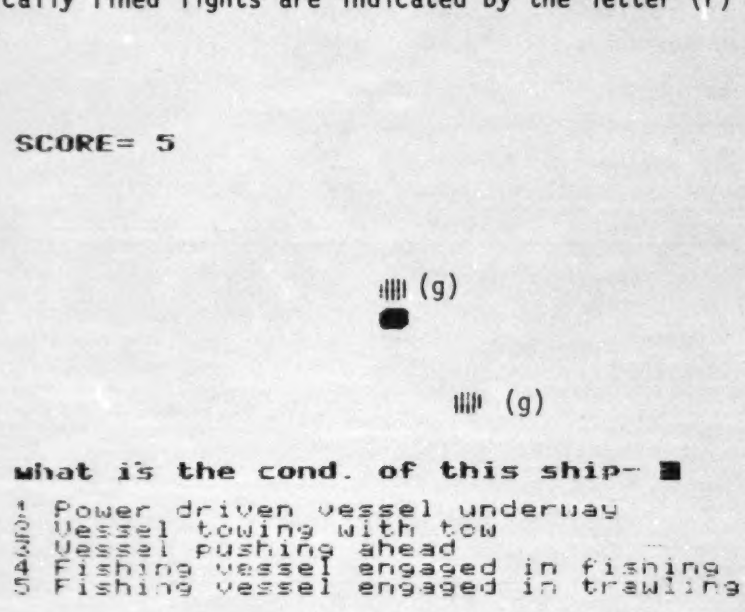
In this section your understanding of
light recognition will be tested

There are two modes of answer - Easy and
Hard. In easy mode there is no time
limit, in Hard there is a 2 second time
limit (MORE POINTS ARE SCORED FOR HARD
HOWEVER)

Enter answer mode (E)asy (H)ard
```

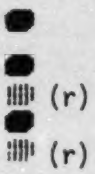
There are two modes of practice, the only difference between them being the speed of response required by the computer. In this demonstration, provision has been made for points to be computed as part of the program to allow competition among team members if desired. Scores appear at the top of each frame. The game sequence is the same regardless of which response option is selected.

In response to selection of the practice mode, a randomly selected light pattern appears on the screen to begin this demonstration game. A sample pattern is shown in the next display. This pattern is only one of a potentially large number of such lighting configurations, all of which are shown in color. In the following displays, solid lights are white; the color of vertically lined lights are indicated by the letter (r) for red and (g) for green.


SCORE= 5
(g)
(g)
what is the cond. of this ship-
1 Power driven vessel underway
2 Vessel towing with tow
3 Vessel pushing ahead
4 Fishing vessel engaged in fishing
5 Fishing vessel engaged in trawling

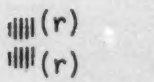
Questions are asked about this light pattern (a vessel engaged in trawling), the answers to which describe the student's assessment of and characteristics of the vessel. Questions asked about each light configuration provide the multiple choice alternatives shown for response. The following displays include sample questions asked about each navigation lighting configuration while providing different examples of those configurations.

```
SCORE= 15
```



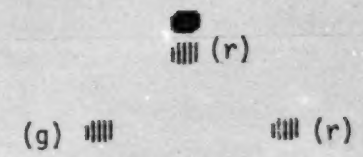
```
what is the cond. of this ship- ■
6  Vessel not under command
7  Vessel restricted in ability to man
8  Vessel at anchor
9  Vessel engaged in pilotage duty
10 Vessel aground
```

```
SCORE= 15
```



```
relative heading- ■
1 toward you
2 away from you
3 to your right
4 to your left
5 unknown
```

SCORE= 15



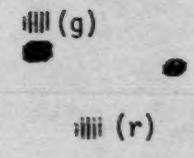
length of vessel- ■
1 less than 50 meters
2 50 meters or more
3 unknown

SCORE= 15

movement- ■

1 Making way
2 Underway, not making way
3 Unknown movement

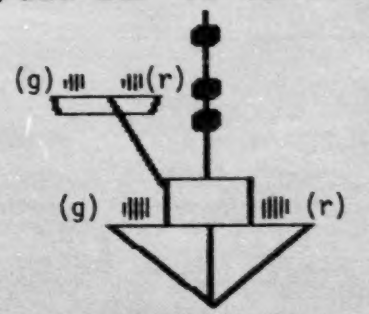
SCORE= 0



gear extended how far- ■
1 more than 150 meters
2 150 meters or less, or not extended
3 Not applicable

So long as the correct response is made to each question for any light configuration, the questions follow in sequence. If an incorrect answer is made to any question, a line drawing appears which shows the actual ship configuration. Correct responses to all questions are also provided.

Press space bar to continue...■



Vessel towing with tow.
Relative heading - toward you.
General length - 50m or more.
Movement - unknown.
General length of tow - 200m or less.

AN EXAMPLE OF A DYNAMIC SIMULATION EXERCISE

While the concept proposed for NR refresher training may be implemented using only operational scenarios, or operational scenarios supported by training games, optional exercises using dynamic computer simulation may also be included to enhance the training provided. A dynamic simulation exercise presents no new material; rather it increases the complexity of the refresher training being provided by presenting exercises which usually include sequential events--that is, something occurs in step one which carries over and influences action in step two, both of which then influence step three, and so on. This capability provides an exercise flexibility not available within the operational scenario, wherein each step is considered in and of itself (i.e., a "snapshot" of a situation).

Because these exercises are expensive and not an integral part of the refresher training strategy, the actual development of a dynamic simulation exercise by TAEG for the Navigation/Piloting subject area was not attempted. However, a commercially available simulation entitled "VALDEZ" which serves to demonstrate this optional part of the strategy was located and purchased.[7] This simulation depicts the movement of a supertanker through the Prince William Sound area of Alaska to its port of Valdez. A map of the area has been transposed into a 256 X 256 element grid and entered into the computer where it appears to the student as a radar display. In the simulation, a ship enters the sound from the North Pacific and during transit must contend with ice floes, islands, and other vessels.

The movement of the ship is prescribed by the player through selection of shaft speed, rudder angle, and estimates of time to complete various evolutions. Movement is based on mathematical equations stored in the computer which incorporate the effects of drag, inertia, engine performance, and ship size. The results of student maneuvering decisions are displayed on the video screen as relative changes in positions between the ship and other objects. Radar navigation is required and several range scales are available for use. A more complete description of this simulation is provided in appendix C.

Computer program expansion and graphics enhancements using available techniques might be applied to the commercial product to incorporate light recognition and maneuvering board problems into this simulation. However, the greater the enhancements package, the higher the anticipated development cost. Many commercially developed simulation programs, similar to VALDEZ, are available on the open market. Further exploration of this strategy for refresher training should include a review of the availability of commercial computer games or programs which might be adapted for use.

[7] VALDEZ, A Supertanker Simulation, Dynacomp, Inc., Pittsford, NY, copyright 1979.

SECTION IV

OBSERVATIONS AND RECOMMENDATIONS

This report describes a concept and its development for implementation for use in providing refresher/proficiency maintenance training in the Naval Reserve. The feasibility of developing materials in support of the concept has been demonstrated. Such materials are well within the state-of-the-art of both instructional design and the application of current technology. However, several questions related to the use of this concept have not yet been resolved. Issues related to the design and use of these techniques which emerged during the development of the prototypes are identified. Recommendations for future actions are presented.

LIMITATIONS OF THE DEMONSTRATION MATERIALS

It should be noted that while the method of arbitrarily selecting instructional tasks and presentation media for the demonstration prototypes served its intended purpose, this selection procedure is not usual. Two important questions associated with the selection process were not addressed. The first such question concerns the kinds and extent of NR refresher training that might be supported by operational scenarios, computer training games and optional dynamic simulation exercises. To assess this issue, a comprehensive listing of tasks required to support identified mobilization billets should be developed and the extent of the requirement for refresher training in each should be identified. For each training task, the usefulness of employing an operational scenario or alternative training technique should then be evaluated. Field trials of the various types of computer delivered exercises may be necessary to identify their effectiveness for specific training tasks.

A second basic question concerns the determination of the efficiency of various forms of computer delivered refresher training. This issue focuses on the cost of creating, applying, and maintaining these materials and software relative to other methods of conducting this training. The relative merits of proposed solutions should be established in terms of development costs, the time required for reservists to regain mastery in the schoolhouse setting using the various methods and media, and the extent to which reservists can perform these skills when they report to their mobilization sites. While the use of a microcomputer as the training delivery system for the prototypes reported here proved highly satisfactory, information on the use of this medium for refresher training is scarce.

The following statements summarize the major training-related issues yet to be addressed:

- The training effectiveness of the operational scenario and training games for refresher or proficiency maintenance training must be established.

- The number of potential NR personnel, by rate or rating, who might benefit from such training must be identified.

- Subject areas and kinds of training most effectively and efficiently taught using these procedures must be identified.

- The costs associated with the development of appropriate materials and supporting software must be determined and documented.

Given satisfactory resolution of these issues, it appears reasonable that an instructional strategy which included operational scenarios and training games, using dynamic simulation exercises as appropriate would serve a useful role in providing proficiency maintenance or refresher training to the Naval Reserve.

Based on this conclusion, the following actions are recommended:

- define the scope of the requirement for the operational scenarios, the training game, and simulation exercises

- define the application of microcomputers to the various components of this instructional strategy

- identify target mobilization billets, and their imbedded training tasks, which might be trained for using these techniques

- develop a meaningful set of training program prototypes using these techniques

- conduct a set of field trials to assess the effectiveness of this approach in the NR environment.

- determine and document the costs of software development, hardware acquisition, maintenance, and associated elements that would be required to establish and maintain the instructional program described.

APPENDIX A

COMPUTER PROGRAM FOR OPERATIONAL SCENARIO TITLED "TACTICAL RESUME"

```
d:b$(8)¦o$(5)
d:t5$(5)¦i$(1)¦c(4)¦n(10)¦c1$(5)¦c2$(5
:)
d:c3$(5)¦ 4$(5)¦c5$(5)¦v7$(6)¦s0$(25)
d:s1$(63)¦p(10)¦p1(10)¦a1$(200)¦a$(1)
d:v1$(28)¦v2$(28)¦r1$(28)¦r2$(28)
d:d1$(28)¦t1$(28)¦f$(3)
c:n(1)=7¦n(2)=12¦n(3)=6¦n(4)=7¦n(5)=9¦n
:(6)=5¦n(7)=7¦n(8)=2¦n(9)=6¦z=1¦f$="nyh"
pr:e
ts:t2
t:
t:
t:
t:    TACTICAL RESUME
t:
t:NAVIGATION & PILOTING
t:
t:(HARBORS & CHANNELS)
ts:s1
pr:t5e
as:
pr:t0e
g:es
t:      TACTICAL RESUME
t:
t:The "Tactical Resume" is a method for
:providing refresher training to Naval
:Reservists. It provides training
:through presentation of a scenario
:that contains events common to an
:operational situation.
t: Under a group
:leader, small groups of participants
:view the events, define and evaluate
:the situation, and recommend courses
:of action to be taken.


t:
t:
th:Press the space bar to continue...
as:
g:es
t: In addition to the scenarios, each
:Tactical Resume contains exercises in
:skill areas associated with the
:topic/subject being studied. Exercises
:available are identified at the
:begining of each subject area.
t:
```

```
th:Press the space bar to continue...
as:
g:es
t: Select a topic or subject area from
:the list below by pressing the
:appropriate letter.
t:
t:(A) Navigation and piloting (Harbors
:& Channels) for officers/ship
:navigations team.
t:
t:(B) Navigation and piloting (Open
:Ocean) for officers/ship navigation
:team
t:
t:(C) Electronic navigation for
:QM/SM/ship navigation team.
t:
t:(D) General damage control for all
:hands.
t:
as:
g:es
t:              NAVIGATION AND PILOTING
T:                HARBORS & CHANNELS
T:
t: The information that follows is
:designed to help you remember and
:review some of the events and actions
:associated with the navigation and
:piloting of a navy ship in harbors and
:channels.
t:
t: The scenario that will be presented
:to you contains specific events that
:require you to define and evaluate a
:situation and to decide on reasonable
:courses of action.
t:
th: Press space bar to continue...
as:
g:es
t: Participants should try to reach
:group consensus when responding to
:questions. The group leader will
:determine how reasonable and acurate
:your decisions are.
t:
t: Since the information describing
:contacts, lights, ship characteristics
:and the like are created randomly,
```

```
:there are no 'correct' answers.
t:
t:
th: Press space bar to continue...
as:
g:es
t: Optional exercises associated with
:this subject are:
t:
t:       (1) Navigation light recognitio
:n
t:       (2) Manuvering board practice
t:
t: If at any time during the senario
:you feel that you need to sharpen your
:skills in one or more of these areas
:you can responed to a question with
:the answer '@' and instructions on how
:to access these modules will appear.
t:
t:
th: Press space bar to continue...
as:
m:P
uy:sysx
g:es
t: From the list below, select the
:harbor you would like for this
:senario.
t:
t: (1) Newport,   R.I.
t: (2) New York,  N.Y.
t: (3) Norfolk,   Va.
t: (4) Charleston S.C.
t: (5) Mayport    Fl.
t:
th: Press the number of your choice...
as:
t:
m:P
uy:sysx
m:2
tn: I'm sorry but New York harbor is the
:only one implemented currently.
t:
jy:nxt1
th: Press space bar to continue...
as:
*nxt1
c:b$="New York":o$="12327"
g:es
```

```
t: You have chosen to pilot through the
:harbor/channel at $b$ . You will need
:to locate chart number $o$  for use in
:this exercise. Other necessary
:equipment includes
t: parallel rulers, dividers, scratch
:paper, blank manuvering board sheets,
:and such reference materials as you
:think you need.
t:
t: I will wait until you have located
:all of these materials.
t:
th: Press space bar to continue...
as:
m:P
uy:sysx
*fool
g:es
t: From the list below, select the type
:of ship you want your 'own ship' to
:be. If you prefer, the computer will
:make a random selection for you.
t:
t: (1) destroyer
t: (2) guided missle frigate
t: (3) combat store ship
t: (4) mine sweeper
t: (5) random selection
t:
th:Enter the number of your selection..
:.
as:#k
m:P
uy:sysx
j(k=0):fool
*juju
c((k=0)!(k>=5)):k=rnd(5)
j(k=0):juju
u(k=1):one
u(k=2):two
u(k=3):three
u(k=4):four
*npt
fix:13,f$
fi:z,a1$
c:a$=a1$(1,1)
c:h=flo(a1$(2,3))
c:s=flo(a1$(5,2))
c:m1=flo(a1$(7,1))
c:m2=flo(a1$(8,1))
```

```
c:c(0)=flo(a1$(9,1))
c:c(1)=flo(a1$(10,1))
c:c(2)=flo(a1$(11,1))
c:c(3)=flo(a1$(12,1))
c:r=flo(a1$(13,4))/100+1
c:b=flo(a1$(17,2))
c:k=z+1+rnd(3)
fi:k,a1$
c:v1$=a1$(1,28)
c:v2$=a1$(29,28)
c:r1$=a1$(57,28)
c:r2$=a1$(85,28)
c:d1$=a1$(113,28)
c:t1$=a1$(141,28)
c:v3=m2-m1
c(v3<>0):v4=m1+rnd(v3)+1
c(v3=0):v4=m2
c:k=rnd(0)
c(k>=.20):s1$="conditions normal.
:                    underway, making way."
u(k<.20):bad
c:k=1
*ships
c:p(k)=rnd(r)*100
c(p(k)<500):p(k)=500
c:k1=rnd(2)
c(k1=0):p1(k)=h-rnd(b)
c(k1=1):p1(k)=h+rnd(b)
*nope
c:j=rnd(4)
j(c(j)=0):nope
c:o=c(j):l=n(o)
c:h1=rnd(l)+1
c:t5$="s1"!!str(c(j))!!"."!!str(h1)
c:a1$="c:c"!!str(k)!!"$=t5$"
xi:a1$
c:k=k+1
j(k<=v4):ships
c:v7$="shafts"
c(s6=1):v7$="shaft"
*nspt
ts:g0,23
th:Press space bar to continue...
as:
m:P
uy:sysx
*frst
g:es
t: Own ship information...
t:
t:   You are piloting a $s0$
```

```
t:
t:                    @s6    @v7@
t:              Length = @18 ft
t:               Width = @w8 ft
t:               Draft = @d8 ft
t:        Displacement = @d7 tons
t:     Maximum speed = @s8 kts
t:Tactical diameter = @t8 yds
t:
th:Press space bar to continue...
as:
m:P
uy:sysx
*plt1
gx:plate1!
ts:t1
ts:g9,4
t:@a@
ts:g26,4
t:@h
ts:g0,5
t:@s
ts:g9,13
t:@v1@
ts:g9,14
t:@v2@
ts:g9,16
t:@r1@
ts:g9,17
t:@r2@
ts:g9,19
t:@d1@
ts:g9,21
t:@t1@
ts:t2
th:Press 'p' for previous page or 'c'
:to continue to the next frame...
as:@i@
m:P
uy:sysx
m:p
jy:frst
g:as
t:           Piloting
t:
t: Your vessel's condition is:
t:
t:@s1@
t:
th:Press space bar to continue...
as:
```

```
m:P
uy:sysx
*menu
g:es
t:Radar range and bearing to contacts:
c:k=1
*more
t: #k ) #(p1(k)) T at #(p(k)) yds.
c:k=k+1
j(k<=v4):more
t:
t:Press the number of the contact to
:view the vessel's lights
t:
t: p) View previous page again
t: c) Continue to next frame
t:
t: *** PROGRESSING TO THE NEXT      ***
t: *** FRAME PROHIBITS SEEING PAST  ***
t: *** FRAMES. BE SURE YOU HAVE ALL ***
t: *** THE NOTES YOU NEED!!!        ***
as:#k $i$
m:P
uy:sysx
m:p
jy:plt1
m:c
jy:nxt
c:p3=p(k)
c:p4=p1(k)
c:a1$="c:t5$=c"!!i$!!"$"
xi:a1$
c:a1$="gx:#5:"!!t5$
g:es
xi:a1$
ts:g0,22
t: #k ) #p4 T at #p3 yds.
th:Press space bar to return to menu...
as:
m:P
uy:sysx
j:menu
*nxt
g:es
t:                G R O U P
t:
t:           Q U E S T I O N S

t:
t:A) What is your location relative to
:point $a$
```

```
t:
t:B) If you are not at point $a$ , what
:caused the discrepancy/deviation and
:what future actions must you take to
:account for it?
t:
t:C) What navigation lights/day shapes
:should you display?
t:
t:D) What are the characteristics of
:the radar contacts?
t:
t:E) What other hazards are present?
t:
t:F) What actions should be taken to
:minimize hazards to your vessel? Why?
c:z=z+4
j(z<13):npt
th:Press space bar to end
as:
m:P
uy:sysx
#bad
c:k=rnd(3)
c(k=0):s1$="rudder not responding to
:commands, making way."
c(k=1):s1$="lost power, drifting"
c(k=2):s1$="you are towing a disabled
:craft (tow less than 200 meters long)"
e:
#one
c:s0$="destroyer"
c:l8=550
c:w8=60
c:d8=30
c:d7=8000
c:s8=30
c:s6=2
c:t8=700
e:
#two
c:s0$="guided missile frigate"
c:l8=440
c:w8=45
c:d8=25
c:d7=3600
c:s8=29
c:s6=1
c:t8=500
e:
#three
```

```
c:s0$="combat store ship"
c:l8=580
c:w8=80
c:d8=25
c:d7=16500
c:s8=20
c:s6=1
c:t8=1500
e:
*four
c:s0$="ocean minesweeper"
c:l8=175
c:w8=36
c:d8=15
c:d7=750
c:s8=14
c:s6=2
c:t8=250
e:
*sysx
g:es
t: Please insert the disks labled with
:module name that you wish to explore
:in the drive numbers printed on them
:and then press the reset button.
a:
e:
```

APPENDIX B

COMPUTER PROGRAM FOR TRAINING GAME ON NAVIGATION LIGHT RECOGNITION

```
d:j$(20);v$(6);l1(10);m$(1);k1(15);c$(20
:)
c:l1(1)=7;l1(2)=14;l1(3)=7;l1(4)=8
c:l1(5)=10;l1(6)=6;l1(7)=8;l1(8)=3
c:l1(9)=7;l1(10)=4;w=0;q1=0;q2=0
ts:t2
t:Welcome to the gaming portion of the
: tactical resume
t:
t:In this section your understanding of
: light recognition will be tested
t:
t:
t:There are two modes of answer - Easy
:and Hard. In easy mode there is no
:time limit, in Hard there is a 2
:second time limit (MORE POINTS ARE
:SCORED FOR HARD HOWEVER)
t:
*nope
th:Enter answer mode <E>asy <H>ard
as:$m$
m:e
jy:easy
m:h
jn:nope
c:h1=1
*easy
g:es
t(h1<>1):Select answer from list then
:press return (no time limit)
t(h1=1):Formulate an answer then
:press return to view a list of
:possible answers.
t(h1=1):You then have 2 seconds to
:answer. if you have not answered in 2
:seconds no points are scored
t:
t:
th:Press the space bar to continue...
as:
*rtry
g:v
g:es
t:SCORE= @w
j(q1=3):dead
j(q2=10):ndead
*over
c:s8=rnd(11)
j(s8=0):over
c:c$="j:l"!!str(s8)
```

```
xi:c$
*begin
c:n=rnd(11(s8))
j(n=0!k1(n)=0):begin
c:c$="gx:#5:s1"!!str(s8)!!"."!!str(n)
c:j$="gx:#4:s1a"!!str(s8)!!"."!!str(n)
xi:c$
g:v0,39,17,23
c:r=0
th:what is the cond. of this ship-
as:
pr(h1=1):t1
gx(s8<=5):q1.1
gx(s8>5):q1.11
as:#r
c:v$=str(k1(n))
c:k=flo(v$(1))
th(r=k):good job
th(r<>k):no sorry
c(r=k):w=w+15
c((r=k)&(h1<>1)):w=w-10
c(r<>k):q1=q1+1
j(q1=3):dead
c(r=k):q2=q2+1
j(q2=10):ndead
c:k8=k;j=1
pr:t0
j(r<>k):wrong
*one
w:1
c:h=k
g:es
j(r<>k):rtry
c:r=0
th:relative heading-
as:
pr(h1=1):t1
gx:q1.2
as:#r
c:v$=str(k1(n));k=flo(v$(2));t1=k
th(r=k):good job
th(r<>k):no sorry
c((r=k)&(h1=1)):w=w+15
c((r=k)&(h1<>1)):w=w+5
c:k8=k-1;j=2
pr:t0
j(r<>k):wrong
*two
w:2
g:es
j(r<>k):rtry
```

```
c:r=0
th:length of vessel-
as:
pr(h1=1):t1
gx:q1.3
as:@r
c:v$=str(k1(n))¦k=flo(v$(3))
th(r=k):good job
th(r<>k):no sorry
c((r=k)&(h1=1)):w=w+15
c((r=k)&(h1<>1)):w=w+5
pr:t0
c:k8=k¦j=3
pr:t0
j(r<>k):wrong
w:2
g:es
c:r=0
th:movement-
as:
pr(h1=1):t1
gx:q1.4
as:@r
c:v$=str(k1(n))¦k=flo(v$(4))
th(r=k):good job
th(r<>k):no sorry
c:w=w+15
c((r=k)&(h1<>1)):w=w-10
c:k8=k¦j=4
pr:t0
j(r<>k):wrong
w:2
g:es
c:r=0
c:k=flo(v$(5))
j(k=3):ghst
th:general length of tow-
as:
pr(h1=1):t1
gx:q1.5
as:@r
c:v$=str(k1(n))
th(r=k):good job
th(r<>k):no sorry
c:w=w+15
c((r=k)&(h1<>1)):w=w-10
c:k8=k¦j=5
pr:t0
j(r<>k):wrong
w:2
g:es
```

```
c:r=0
*ghst
c:k=flo(v$(6))
j(k=4):rtry
th:gear extended how far-
as:
pr(h1=1):t1
gx:q1.6
as:#r
c:v$=str(k1(n))
th(r=k):good job
th(r<>k):no sorry
c:w=w+15
c((r=k)&(h1<>1)):w=w-10
c:k8=k:j=6
pr:t0
j(r<>k):wrong
g:es
j:rtry
*11
c:k1(1)=111343
c:k1(2)=112343
c:k1(3)=141343
c:k1(4)=131343
c:k1(5)=142343
c:k1(6)=132343
j:begin
*12
c:k1(1)=211323
c:k1(2)=211313
c:k1(3)=212323
c:k1(4)=212313
c:k1(5)=231323
c:k1(6)=231313
c:k1(7)=232323
c:k1(8)=232313
c:k1(9)=241323
c:k1(10)=241313
c:k1(11)=242323
c:k1(12)=242313
c:k1(13)=223343
j:begin
*13
c:k1(1)=311343
c:k1(2)=312343
c:k1(3)=331343
c:k1(4)=332343
c:k1(5)=341343
c:k1(6)=342343
j:begin
*14
```

```
c:k1(1)=453242
c:k1(2)=413242
c:k1(3)=413141
c:k1(4)=433142
c:k1(5)=443142
c:k1(6)=423142
c:k1(7)=423141
j:begin
*15
c:k1(1)=551243
c:k1(2)=512243
c:k1(3)=512143
c:k1(4)=511143
c:k1(5)=541143
c:k1(6)=542143
c:k1(7)=531143
c:k1(8)=532143
c:k1(9)=523143
j:begin
*16
c:k1(1)=653243
c:k1(2)=613143
c:k1(3)=633143
c:k1(4)=643143
c:k1(5)=623143
j:begin
*17
c:k1(1)=753243
c:k1(2)=711143
c:k1(3)=712143
c:k1(4)=711123
c:k1(5)=741143
c:k1(6)=731143
c:k1(7)=723143
j:begin
*18
c:k1(1)=832443
c:k1(2)=842443
j:begin
*19
c:k1(1)=913143
c:k1(2)=943143
c:k1(3)=933143
c:k1(4)=923143
c:k1(5)=953543
c:k1(6)=953243
j:begin
*110
c:k1(1)=042443
c:k1(2)=032443
c:k1(3)=051443
```

```
j:begin
*wrong
g:es
g:v
xi:j$
th:Press space bar to continue...
as:
j:rtry
*ndead
g:es
t:***** GREAT JOB I CAN'T COMPETE  ****
T:***** AGAINST YOU ANY LONGER     ****
j:lst
*dead
g:es
t:***** REMIND ME NOT TO GO SAILING
T:***** WITH YOU!!!
*lst
t:FINAL SCORE= #w
pr:t5
as:
```

APPENDIX C

VALDEZ--A SUPERTANKER SIMULATION
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DYNACOMP

VALDEZ

APPLE II

DYNACOMP, Inc. 6 Rippingale Road Pittsford, New York 14534

DYNACOMP
P.O. BOX 162
WEBSTER, N.Y. 14580

SPECIAL USER NOTES FOR THE APPLE VERSION OF

VALDEZ

Congratulations on your purchase of the Apple II version of VALDEZ. We believe you will find VALDEZ to be both an informative and enjoyable simulation. VALDEZ is a unique program which contains a 65536-point map of the Prince William Sound area of Alaska. This map is specially encoded within the program and is 'visible' through the radar display.

The Apple version of VALDEZ is very similar to the North Star version, with a few exceptions which are due to the particular hardware and software properties of the Apple II. The North Star documentation may be generally used to understand the operation of VALDEZ, but with the following changes:

1) The VALDEZ map is automatically loaded with the program. This program is recorded on both sides of the cassette. The user does not have the option, as in the North Star version, of loading an 'open sea' map. This is an improvement made possible by the software structure of the Apple II.

2) VALDEZ was advertised to run within 16 kilobytes of program memory. However, a '16K' Apple II Plus really has only about 14 kilobytes free for programming. Also, program storage in the Apple II appears to be considerably less efficient than in the TRS-80 or North Star. We have therefore shortened the program to accomodate these deficiencies. The result is that there is no error check on the random number generator seed requested by the program. There is also no check on the validity of the radar range multiplier input. For the random number generator input, the proper range of values is 0 to 1. For the radar range, the proper values are 0, 1, 2, 4, 8, 16 and 32.

Because of the high degree of compression, listings of the program are very difficult to read. Also, a program listing will not disclose the map. The map is loaded as part of the BASIC program, but will not be displayed under the command "LIST".

For those Apple owners having disk systems, the program on cassette may be loaded and directly saved on disk. Do not run the program before saving as the map will be affected (ghost ships may appear on your display later).

You should experience few problems loading the cassette. As an Apple user, you are probably aware that the tape recorder tone level should be set to maximum, and the volume adjusted. In using the Apple II Plus, we have found the volume adjustment to be less critical than expected if the following procedure is used. After setting the volume and tone levels, type 'LOAD' and start the recorder. Immediately type the carriage return which completes the command. If, at the beginning of the tape, the Apple responds with "ERR", stop the tape immediately. Turn off the computer (for some reason, a simple RESET is not sufficient). Turn the computer back on, type 'LOAD', start the tape recorder, and quickly type a carriage return. Often the program will successfully load following this procedure. It may be that the greatest volume sensitivity is at the transition from the no-program signal to the signal corresponding to the continuous tone lead-in. After the transition is passed, you can be reasonably sure of a good load.

Although you should experience no difficulty in loading and running VALDEZ, if you do, please feel free to contact DYNACOMP. Our goal is to make you a satisfied customer.

DYNACOMP
P.O. BOX 162
WEBSTER, N.Y. 14580

VALDEZ - A SUPERTANKER SIMULATION
VERSION 2.0

VALDEZ is a microcomputer simulation of supertanker navigation in the Valdez region of Alaska. See the attached figure. Valdez is terminal port for the Alaskan oil pipeline. To get to Valdez harbor, supertankers must enter Prince William Sound from the North Pacific and cross that body of water to Valdez Narrows. Crossing this sound is complicated by the presence of islands, moving icebergs, and other supertankers heading for the North Pacific. Valdez Narrows itself is very treacherous as the passage is only 900 meters wide. Careful maneauvering (in the presence of tides) is required.

The program carefully simulates the above real life features of supertanker navigation in the following ways:

1) The movement of the supertanker under your control is simulated through equations which describe the effects of drag, inertia and engine performance.

2) A detailed map of the Prince William Sound area is stored bit-wise in the computer's memory. The storage is fairly efficient and covers a 256 by 256 element grid. The spacing between the grid points is 500 meters. Included on this grid are the coastline and islands as they appear on a recent Rand-McNally map.

3) The passage to Valdez is complicated by the presence of icebergs which originate from the Columbia Glacier. These icebergs are included in the simulation. Their motion is governed by the tides.

4) The tidal patterns of the Prince William Sound area are also simulated both with respect to time and position. These tides must be particularly reckoned with when entering the Narrows as there is not much room for error.

5) Other supertanker traffic is included. This traffic consists of several ships following a course from Valdez to the Pacific. This on-coming danger is particularly acute within the Narrows and harbor area.

Operation of the simulation is straight-forward. Most of the prompts are self-explanatory. The reader is referred to the attached annotated run listings for examples. However, to avoid confusion, a few of the responses will be discussed here. Observe that there is also an "instructions" option when running the program in the full version (17 kilobytes for the program plus 8 kilobytes for the map).

Because the map is very detailed (256 by 256), it is stored in the computer's memory in a bit-wise manner. The map is located outside the program space used by BASIC. This means that the usual practice of setting the user memory size to the maximum available must not be followed. Where this map memory space is to reside depends on the memory bound set by the user. In the North Star BASIC case, one can use the memory above BASIC by responding to "WHERE IS THE MAP TO BE STORED IN MEMORY (DECIMAL): ?" with a value one greater than the MEMSET number given earlier (see the sample run listing). For example, if the top of memory was set to 48000 via the MEMSET command, then the map storage could start at 48001. Note that the map requires 8 kilobytes of memory! The map may also be stored starting at location 0 in memory. This would use the entire region in front of the standard location of the DOS. The program runs perfectly well with the map in that location, but the DOS is affected and will not save programs properly later. However, the DOS can simply be reloaded after exercising the simulation. In summary, the user must decide on where to store the 8 kilobyte map and must be sure that the region is safe from unintentional alteration by BASIC. In general, if the program memory boundary can be set 8192 bytes lower than the maximum available, while still leaving enough space to run the program, there should be no problem.

The simulation can be run in several modes. The program will ask whether or not an open sea exercise is desired. If the answer is "Y", then a blank map will be loaded (i.e., no coastline or islands). In this mode one can practice maneuvering the supertanker. As the other ship and iceberg traffic is overlaid on this map, you can practice precision navigation in chasing and ramming other ships. This is not an easy task as the other ships are also moving, and careful navigation is required for interception. Remember, supertankers do not respond to controls quickly. Large masses

do not change direction and speed without considerable effort.

If you answer "N" to the open sea practice simulation question, there is another decision point. The next question is whether or not the Prince William Sound map should be loaded. The reason for this question is that you may have ended one round of simulation and want to start again. Because the map is still in the computer's memory, there is no reason to reload it. Note that loading the map takes some time because it is so large. If you answer "Y", the map will be loaded. If instead the answer is "N", and the VALDEZ map had not been previously loaded, then the radar display will reflect whatever random patterns there are in the reserved region of memory. This will often look like many irregularly distributed islands, and can be used as a map in itself. The objective then would be to not run aground.

If the Prince William Sound map is loaded, some realistic navigation can be performed. As the map is extensive, you can simply sail around the sound, circumnavigate islands, travel up fiords, and so on. You can also attempt the challenge of mooring at Valdez. First you have to get to the harbor. Second you have to pull up to a floating pipeline terminal located at a particular position. There are also requirements on the orientation of the tanker at final docking. These requirements are given in the "instructions" included in the full version of the program, and also listed separately.

Control of the ship is through the rudder and two engines. The rudder control is given in degrees (-45 to +45), and the engine power is given in percent. For example, full ahead would be 100(%), half reverse would be -50(%). Having two engines comes in handy in case one breaks down (which can happen!). The prompts for these controls are self-explanatory, as are the status displays. However, the radar display requires some discussion.

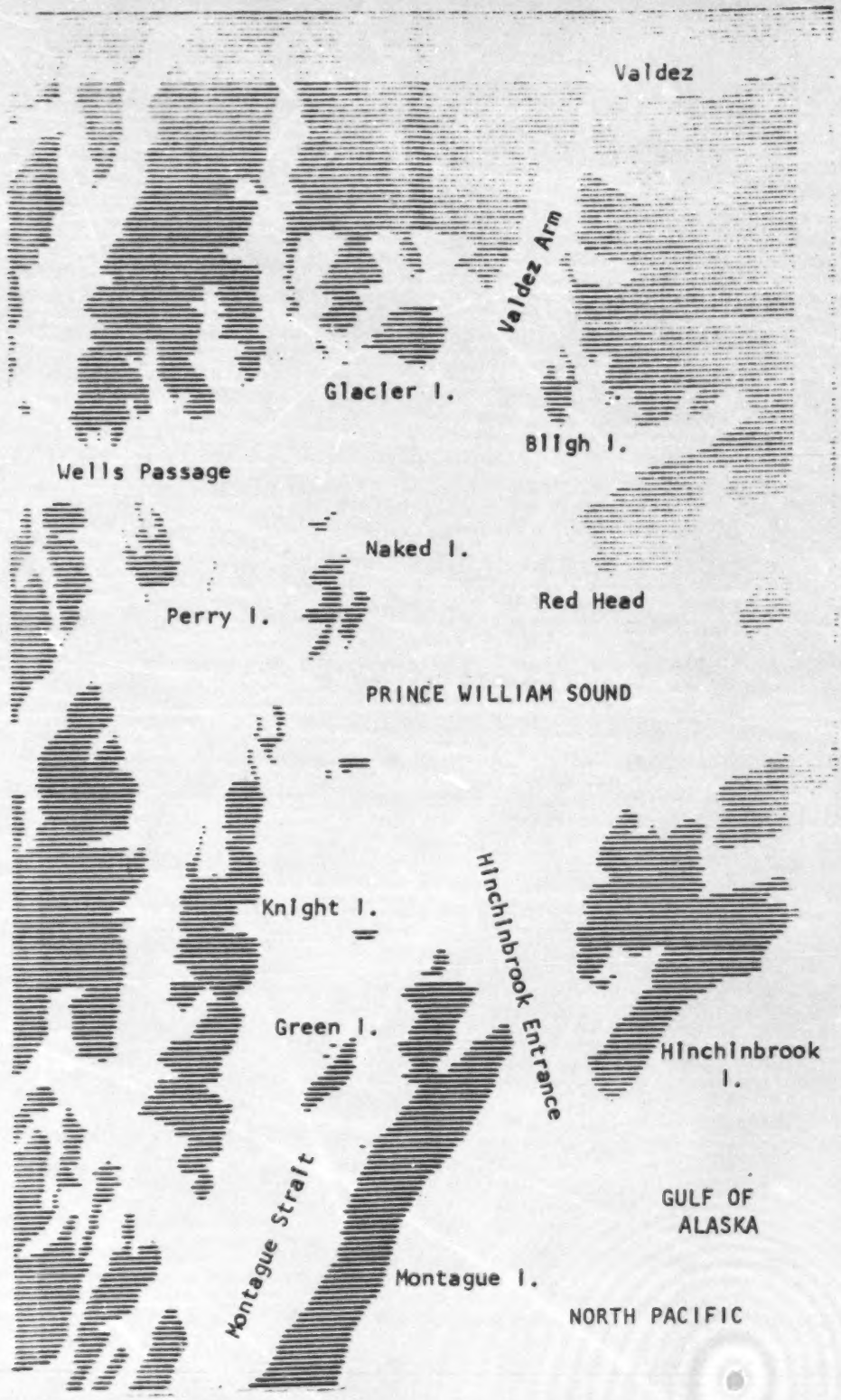
The simulation behaves as if the fog is very thick and the information is all electronic. As the Coast Guard maintains very tight monitoring of the traffic in the sound, the locations of all other traffic is known fairly accurately. However, curious as it may be, even when ships see one another, they still manage to collide. To aid the captain in avoiding collisions and skirting coasts, variable range radar is supplied. This radar has magnifications of 1x, 2x, 4x, 8x, 16x and 32x. A magnification of 1 gives the highest resolution and will show everything within range. A magnification of 32 has a course resolution, but will display the entire map (the region outside the map is shown as land). You will find that the various magnifications are very useful. Note that responding to the radar range factor prompt with a "0" will skip the plot. Skipping the radar display is often desirable as it takes some time to print; it is 16 by 16 grid elements, and the map must be unraveled from memory.

The display portions of the simulation were designed to be compatible with terminals having line widths of 32 or more characters. This placed a limit on the size of the radar display. For those with wider terminals, the appropriate change can be made in the FOR/NEXT loop arguments in the radar display subroutine. This might be desirable since for radar range factors larger that 1, there is a strong possibilty that other ship and iceberg traffic will be missed because of the reduced resolution.

In running the simulation, most of the execution time is spent calculating the ship and iceberg movements. The motion is calculated in ten iterative steps. During periods of excitement, the delay becomes particularly apparent. However, if you consider the number of calculations performed, as well as the completeness of the simulation, the time gap is really not that great.

Additional comments:

The computer map is square and laid out in the following way. The lower left corner is designated as the origin. Its coordinates are X=0 kilometers and Y=0 kilometers. The upper right hand corner is at X=127.5 kilometers and Y=127.5 kilometers. Up is North; right is East. The supertanker starts its simulated course at X=125 kilometers, Y=0. This is very close to the lower right corner. The initial course direction is -45 degrees off North, which is Northwest. This course is in the direction of Hinchinbrook Entrance, but not exactly. Some course correction is required to accurately enter the passage. Once within the pass, a due North course is advised. This will bring the ship into the vicinity of Valdez Arm, which leads to the Narrows and thence to the port. A considerable amount of navigation is necessary to pass through the arm to the port. The final mooring coordinates are X=108 kilometers and Y=123 kilometers.



VALDEZ map as contained in the computer's memory. The actual map is square with 256 grid elements on a side. The display above was created by printing the memory contents as blanks (for "0") and asterices (for "1"). Lines of asterices give the appearance of TV raster lines, and indicate the resolution provided in the simulation.

'VALDEZ' IS A COMPUTER SIMULATION OF SUPERTANKER TRAFFIC IN THE PRINCE WILLIAM SOUND AREA OF ALASKA. THE OBJECT OF THE SIMULATION IS TO MANEUVER A LARGE SUPERTANKER THROUGH THE SOUND AND VALDEZ NARROWS TO AN OIL PIPELINE TERMINAL AT VALDEZ.

THE SIMULATION IS COMPLICATED BY SEVERAL REALISTIC PROBLEMS. FIRST, A DENSE FOG IS ASSUMED. THIS REQUIRES ALL NAVIGATION TO BE PERFORMED USING COMPASS HEADINGS AND RADAR DISPLAYS. THE RADAR DISPLAY IS MULTIPLE RANGE AND IN THE SHORT RANGE SETTING HAS A RESOLUTION OF 500 METERS. THIS RESOLUTION IS PARTICULARLY IMPORTANT IN PASSING THROUGH THE NARROWS WHERE THE LEEWAY IS ONLY 900 METERS. ANOTHER DANGER IS OTHER SEA TRAFFIC, INCLUDING BOTH SHIPS AND ICEBERGS. A CONSIDERABLE AMOUNT OF SHIPPING IS LEAVING VALDEZ HARBOR AND PASSING THROUGH THE NARROWS. THIS ONCOMING TRAFFIC MUST BE AVOIDED. THESE SHIPS FOLLOW A PARTICULAR SEA LANE, BUT THE DEPARTURES ARE RANDOM. THE ICEBERG TRAFFIC IS REALISTICALLY MORE RANDOM. THE ICEBERGS ORIGINATE AT THE TIP OF THE COLUMBIA GLACIER AND ARE SUBJECT TO THE TIDES, WHICH ARE ALSO SIMULATED. THE ICEBERGS THEREFORE MOVE SLOWLY, BUT CROSS THE SEA LANES.

TWO BASIC CONTROLS ARE AVAILABLE TO THE CAPTAIN. THEY ARE ENGINE POWER (TWO ENGINES) AND HELM (RUDDER). IT IS ASSUMED THAT A CONTROLLED HELM IS IN PLACE SO THAT ONCE THE COMMAND IS SET, IT REMAINS UNTIL INTENTIONALLY ALTERED.

THE SIMULATION IS AN EXERCISE IN PRECISION NAVIGATION. THE NAVIGATION IS RELATIVE TO A 256 X 256 GRID HAVING 500 METER SPACINGS. ALL DISTANCES ARE IN METERS. THE PORT IS LOCATED AT GRID POSITION X=108 KILOMETERS (LONGITUDE) AND Y=123 KILOMETERS (LATITUDE). FINAL MOORING IS NEXT TO A FLOATING PIPELINE TERMINAL. THE ANCHOR WILL BE DROPPED UNDER THE FOLLOWING CONDITIONS:

POSITION: WITHIN 100 METERS OF TERMINAL
HEADING: BETWEEN 80 AND 100 DEGREES OFF NORTH
SPEED: LESS THAN 0.7 KILOMETERS/HOUR

COLLIDING WITH ANOTHER SHIP OR AN ICEBERG ENDS THE SIMULATION. SO DOES RUNNING AGROUND. A COLLISION REPORT IS GIVEN DESCRIBING THE DAMAGE.

THE SIMULATION MAY BE EXERCISED IN TWO GENERAL WAYS. BY CLEARING A PATCH OF SEA WHEN GIVEN THE OPTION YOU CAN PRACTICE WIDE RANGING MANEUVERS AS WELL AS ATTEMPT TO INTERCEPT OTHER SHIPS. BY LOADING THE PRINCE WILLIAM SOUND MAP, THE FULL SIMULATION MAY BE EXERCISED.

REMEMBER, SUPERTANKERS ARE BIG AND SLUGGISH IN HANDLING. CAREFULLY PLAN YOUR COURSE!

Instructions as they are printed out when running the 25 kilobyte version of VALDEZ. The instructions option has been removed from the compressed versions.

Sample listings for the North Star version of VALDEZ. Other versions are similar.

```
MEMSET 31600
READY
```

- Set the memory boundary such that at least 8K (8192) bytes of memory are free for map storage, with also 8K available to run the program. In the example shown (North Star, using Release 4 BASIC), approximately 8100 bytes are available for the program.

```
LOAD VALDEZC
READY
```

- Load the compressed version of VALDEZ. The full version requires in excess of 17 kilobytes for the program itself, and an additional 8 kilobytes for the map. The compressed versions are built from the 17K program by removing REM statements, blanks, and by concatenating.

```
RUN

VALDEZ - A SUPERTANKER SIMULATION

NORTH STAR VERSION NSCV1.0
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WEBSTER, NEW YORK
```

- Other versions available include compressions for the 16K Level II TRS-80 and 16K PET.

```
SIMULATION BEGINS.....

INPUT A NO. BETWEEN 0 AND 1000?46
```

- This randomizes the distribution of icebergs and ships.

```
WHERE IS THE MAP TO BE
STORED IN MEMORY (DECIMAL): ?31601
```

- Input the first free memory location. Normally this is one greater than the memory bound.

```
IS THIS TO BE AN OPEN
SEA PRACTICE SIMULATION (Y/N): ?N
```

- If "Y", then a clear patch of sea is prepared instead of the map.

```
IS PRINCE WILLIAM MAP LOADED (Y/N): ?N
LOADING PRINCE WILLIAM SOUND MAP....
```

- If "Y", the program assumes the map has already been loaded into the memory region indicated above. Not clearing the sea or loading the map will result in a randomized pattern unless the map had been loaded in an earlier play.

```
STATUS
------
TIME:  9.35 HOURS
POSITION:
     125 KM EAST
     0 KM NORTH
WATER SPEED:  18.9 KM/HOUR
TIDE:  4.9 KM/HOUR SOUTH
HEADING : -45 DEGREES OFF NORTH
PORT ENGINE POWER:  75%
STARBOARD ENGINE POWER:  75%
HELM:  0 DEGREES
```

- The supertanker always starts from the same location (near the lower right of the map).
- South is general; it might be southeast.
- Current direction of travel.
- The engines supply power additively. Power can range from -100% to +100%.
- Angle of the rudder. When moving forward, a positive angle corresponds to turning right.

```
RADAR RANGE CONTROL
-------------------

RADAR RANGE FACTOR: ?32
GRID INCREMENT:  16 KILOMETERS
```

- The navigational display. Open sea is shown as dots; land, icebergs and other ships as asterices. The radar range factors allowed are 0, 1, 2, 4, 8, 16 and 32. A "0" input is used to skip the display. If the supertanker were in the center of the map, a range factor of 16 would display the map in its entirety. The area outside the map boundaries is treated as solid land. In the example to the left, the upper right hand quadrant represents the stored map. The other three quadrants are outside the map boundary. The "0" denotes the location of the supertanker. The radar display is always centered on this ship. The resolution is poor when using high magnifications. However, some of the large features shown on the attached map are apparent in this display.

```
CONTINUE?Y
```

- The "CONTINUE" prompts are designed for 16 line video monitors. The object is to keep the data from scrolling of the screen before it is read.

```
DISPLAY OTHER TRAFFIC (Y/N): ?Y

LAST REPORTED SHIP POSITIONS
----------------------------

 1    X= 91.1    Y= 120.4
 2    X= 88.5    Y= 116.3
 3    X= 79.5    Y= 76.1
 4    X= 83.4    Y= 108.1
 5    X= 79.5    Y= 32
 6    X= 85.6    Y= 111.7

CONTINUE?Y

LAST REPORTED ICEBERG POSITIONS
-------------------------------

 1    X= 71    Y= 85.6
```

- The number of ships and their initial locations are chosen according to the random number generator seed given above. These ships follow a set course from Valdez, down the Valdez Arm, across the Prince William Sound, through the Hinchinbrook Entrance and into the Gulf of Alaska.
- The icebergs drift with the tide.

```
CONTINUE?Y

ENGINE CONTROL
--------------

STATUS: PORT  75% AHEAD
        STARBOARD  75% AHEAD

CONTINUE CURRENT STATUS (Y/N)?Y

RUDDER CONTROL
--------------

STATUS:  0 DEGREES  RUDDER

CONTINUE CURRENT STATUS (Y/N)?Y

HOW MANY MINUTES IS THIS SPEED
AND HEADING TO BE MAINTAINED: ?30

STATUS
------
TIME:  9.85 HOURS
POSITION:
     117.56 KM EAST
     6.91 KM NORTH
WATER SPEED:  21.4 KM/HOUR
TIDE:  .5 KM/HOUR SOUTH
HEADING : -45 DEGREES OFF NORTH
PORT ENGINE POWER:  75%
STARBOARD ENGINE POWER:  75%
HELM:  0 DEGREES

RADAR RANGE CONTROL
-------------------

RADAR RANGE FACTOR: ?8
GRID INCREMENT:  4 KILOMETERS

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CONTINUE?Y

DISPLAY OTHER TRAFFIC (Y/N): ?Y

LAST REPORTED SHIP POSITIONS
----------------------------

 1    X= 86.3   Y= 112.8
 2    X= 83.7   Y= 108.7
 3    X= 79.5   Y= 67.1
 4    X= 79.5   Y= 100.3
 5    X= 79.5   Y= 23
 6    X= 80.8   Y= 104.1

CONTINUE?Y

LAST REPORTED ICEBERG POSITIONS
-------------------------------

 1    X= 70.9   Y= 85.2

CONTINUE?Y
```

- Engine power can range from -100% to +100%. Each engine can be individually controlled. It is possible for an engine to fail without warning. Also, engine damage occurs with collisions.

- The rudder is controlled by inputting an angle. 30 degrees left rudder would be set by answering the question to the left with "Y", and then responding with "-20" when prompted.
- This is how long the ship will travel before a new command may be entered. It is as if the ship controls were set and the captain went for coffee.

- Time has increased by 0.5 hours.

- The ship has moved 7.44 kilometers to the west, 6.91 kilometers to the north; a total of about ten kilometers.
- Note, the tide is changing slowly.
- Same heading as before. However, note that the heading is relative to the map and the tide causes the actual course direction to be a little different.

- A good value for long range scanning.

- The lower left part of Hinchinbrook Island is visible. The entrance to the sound is on the far side of this. The present course is at 45 degrees and intersects this arm. A course change will be necessary.

- Note that the supertanker has moved on the map. This can be seen relative to the map boundary.

  If there were other ship traffic within the field of view of the radar, it would have one chance in sixty-four (8x8) of being displayed because of the low resolution.

Note that this ship has moved about five kilometers to the west and about eight to the south. It is travelling down Valdez Arm.

This ship has moved nine kilometers south. It is exiting the Hinchinbrook entrance and heading into the Gulf of Alaska.

-The iceberg has moved south 0.4 kilometers.

A different example showing a collision

```
STATUS
------
TIME:  9.37 HOURS
POSITION:
     79.3? KM EAST
     74.3 KM NORTH
WATER SPEED:  19 KM/HOUR
TIDE:  .5 KM/HOUR SOUTH
HEADING : 5 DEGREES OFF NORTH
PORT ENGINE POWER:  75%
STARBOARD ENGINE POWER:  75%
HELM:  5 DEGREES RIGHT RUDDER
```

- Ship is located between Naked Island and Red Head; open water.
- Course almost due north. A course correction had been made recently in order to head more directly into Valdez Arm.
- Still in the process of correcting course.

```
RADAR RANGE CONTROL
-------------------

RADAR RANGE FACTOR: ?1
GRID INCREMENT:  .5 KILOMETERS
```

- Maximum resolution is used here as there is likely to be other shipping in the area.

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CONTINUE?Y
```

- Something has appeared on the radar display. Since we know that the current supertanker location is in open water, the radar target is either another ship or an iceberg.
- According to the display, the target is ahead about 1.5 kilometers.

```
DISPLAY OTHER TRAFFIC (Y/N): ?Y

LAST REPORTED SHIP POSITIONS
----------------------------

 1    X= 90.9    Y= 120.2
 2    X= 88.3    Y= 116
 3    X= 79.5    Y= 75.8
 4    X= 83.2    Y= 107.9
 5    X= 79.5    Y= 31.7
 6    X= 85.4    Y= 111.4

CONTINUE?Y
```

- This is the other ship. This is determined by comparing the position of our ship as given under "STATUS" above with the positions on this list. Ship #3 is ahead 1.5 kilometer north, 180 meters east. We are heading right for it!

```
LAST REPORTEI  ICEBERG POSITIONS
--------------------------------

 1    X= 71    Y= 85.6

CONTINUE?Y
```

- There is also an iceberg roughly fifteen kilometers away.

```
ENGINE CONTROL
--------------

STATUS: PORT  75% AHEAD
   STARBOARD  75% AHEAD

CONTINUE CURRENT STATUS (Y/N)?Y

RUDDER CONTPOL
--------------

STATUS:  5 DEGREES  RIGHT RUDDER

CONTINUE CURRENT STATUS (Y/N)?Y
```

- No change. We are going to see what happens when there is a collision.

```
HOW MANY MINUTES IS THIS SPEED
AND HEADING TO BE MAINTAINED: ?5

**************************
**************************

COLLISION WITH SUPERTANKER!!!

***MAJOR COLLISION***
TAKING ON WATER
ENGINE STATUS FOR PUMPING:
    PORT:  34%
    STARBOARD:  0%
PUMP POWER INSUFFICIENT. SINKING.
READY
```

- The other ship is travelling south at 14 kilometers per hour (slow because it is loaded), and we are travelling north at 19 kilometers per hour. The impact speed will be 33 kilometers per hour and occur in less than two minutes.
- A considerable amount of engine power has been lost; too much. The pumps can not keep up.

Successful mooring example. Getting to this position is difficult.

```
STATUS
------
TIME:  9.35 HOURS
POSITION:
     107.8 KM EAST
     123.19 KM NORTH
WATER SPEED:  .7 KM/HOUR
TIDE:  .5 KM/HOUR SOUTH
HEADING : 85 DEGREES OFF NORTH
PORT ENGINE POWER:  0%
STARBOARD ENGINE POWER:  0%
HELM:  0 DEGREES

RADAR RANGE CONTROL
-------------------

RADAR RANGE FACTOR: ?1
GRID INCREMENT:  .5 KILOMETERS

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CONTINUE?I

DISPLAY OTHER TRAFFIC (Y/N): ?N
CONTINUE?I

ENGINE CONTROL
--------------

STATUS: PORT STOPPED
        STARBOARD STOPPED
CONTINUE CURRENT STATUS (Y/N)?I

RUDDER CONTROL
--------------

STATUS:  0 DEGREES  RUDDER

CONTINUE CURRENT STATUS (Y/N)?N
HELM CONTROL (DEGREES): ?-30

HOW MANY MINUTES IS THIS SPEED
AND HEADING TO BE MAINTAINED: ?1

STATUS
------
TIME:  9.4 HOURS
POSITION:
     107.82 KM EAST
     123.16 KM NORTH
WATER SPEED:  .7 KM/HOUR
TIDE:  .5 KM/HOUR SOUTH
HEADING : 85 DEGREES OFF NORTH
PORT ENGINE POWER:  0%
STARBOARD ENGINE POWER:  0%
HELM:  30 DEGREES LEFT RUDDER
```

- The object is to get to the mooring position which is located at X=108 kilometers (north), Y=123 kilometers (east).
- This is the maximum speed at which the anchor may be dropped. Some headway must be maintained as there is a tide to be overcome.
- The tide is actually toward the south-southwest (SSW).

- Here is a chance to get a view of the east end of valdez harbor area. Compare this with the map.

- Compare the scale here with the attached map. Other areas which offer interesting challenges in navigation are Wells Passage and Montague Strait. Getting into the hook in Hinchinbrook Island (off Hinchinbrook Entrance) is difficult, as are some of the fiords.

- No need to check on other traffic. None is visible on the radar display.

- This is a tricky choice. If forwards engines are used, the mooring speed will be exceeded. If reverse engines are used, there may not be enough headway against the tide. In any case the mooring position is only a few hundred meters off.

- A feeble attempt is made to turn into the tide.

- Note that the tide has carried the ship 30 meters south while the headway was only 20 meters.

- Travelling so slow, we can not expect the left rudder to have much effect.

```
RADAR RANGE CONTROL
-------------------

RADAR RANGE FACTOR: ?0
```

- No point in displaying; there has been nearly no change in position.

```
DISPLAY OTHER TRAFFIC (Y/N): ?N
CONTINUE?Y

ENGINE CONTROL
--------------

STATUS: PORT STOPPED
        STARBOARD STOPPED
CONTINUE CURRENT STATUS (Y/N)?Y

RUDDER CONTROL
--------------

STATUS:  30 DEGREES  LEFT RUDDER

CONTINUE CURRENT STATUS (Y/N)?Y

HOW MANY MINUTES IS THIS SPEED
AND HEADING TO BE MAINTAINED: ?20
```

- The only thing to do now is to drift into the mooring area.

```
DROP ANCHOR!!!
OIL DEBARKATION POSITION REACHED
SAFELY. CONGRATULATIONS.
TIME IS  9.74 HOURS

READY
```

We made it!

```
RADAR RANGE CONTROL
-------------------

RADAR RANGE FACTOR: ?1
GRID INCREMENT:  .5 KILOMETERS
```

```
CONTINUE?Y

DISPLAY OTHER TRAFFIC (Y/N): ?Y

LAST REPORTED SHIP POSITIONS
----------------------------

 1    X= 90.8    Y= 119.9
 2    X= 88.2    Y= 115.7
 3    X= 79.5    Y= 75.4
 4    X= 83    Y= 107.6
 5    X= 79.5    Y= 31.4
 6    X= 85.3    Y= 111.1

CONTINUE?Y

LAST REPORTED ICEBERG POSITIONS
-------------------------------

 1    X= 71    Y= 85.6
```

An example of "ghosts"

Ghosts are mysterious small islands which appear after the simulation has been run more than once without loading in a "fresh" map. What happens is that when a simulation has ended, either by collision or successful mooring, the iceberg and ship markers are not removed and show up as land on the next map unless a new map is loaded. For example, of the two images shown to the left, one represents a moving ship while the other is a ghost. Which is which?

Which of these ships (if any) corresponds to the radar images above?

To find out you can:

1) Compare your location against the radar display and ship location list.
2) See which one is stationary (land).
3) Run one down to see what type of collision has occurred.

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